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DRAWINGS ATTACHED

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(54) LIQUID WHEEL-BALANCING SYSTEM

(71) We, SUNLAND REFINING CORPORATION, a Corporation organized under the laws of the State of Nevada, United States of America, of East and California Streets, Fresno, California, United States of America, do hereby declare the invention, for which we pray that a Patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a tire balancing material and method of wheel balancing, and particularly to the use of a weighting material, which, due to its consistency and the use of a position retaining material, can adjust itself to correct imbalances which may occur or exist in a tire and its wheel. This is a continuous process and, creates a substantially complete balance within a tire, whereby external weights, such as are presently used, are rendered unnecessary.

Heretofore methods and materials have been used in attempts to statically and dynamically balance tire and wheel combinations, but primarily these have consisted in use of free moving globular material, such as lead shot, or a free flowing liquid, such as mercury, and each time the wheel has stopped the material has settled to the bottom of the tire, after which it has been necessary to recreate a balanced condition upon initiation of rotation of the tire. One of the primary difficulties in the use of such material is that each time rotation of the tire is stopped, settlement of the weighting material occurs and it has been found that the settlement of the material tends to cause interior tire wear.

According to the present invention, there is provided a tire balancing material comprising a particulate, flowable, weighting material; a viscous, substantially non-hardening, positional retaining material having the weighting material suspended therein in discrete particulate form, the weighting material being of a higher specific gravity than the positional retaining material for appreciable centrifugation therefrom incident to tire rotation, said weighting material in use being releasably retained in position in the tire by said positional retaining material upon said centrifugation, and a non-drying liquid conveyor.

This balancing material is deposited in the interior of a tire. The characteristics of the weighting material not only tend to preserve the interior of the tire but also act during tire rotation to distribute weighted particles or material on to that portion of the tire which is lighter in weight, as compared with a heavier unbalanced portion of a tire or tire and wheel combination. The balancing material includes a liquid conveyor which may act as a feathering material to trim or smooth out the weight distribution, thereby effecting a tire and wheel balance. Under operating conditions of a vehicle, if a new imbalanced condition occurs, the weighting material gradually moves to a new position to again balance the wheel and tire aided by means of the positional retaining material and liquid conveyor. However, when rotation of the wheel is stopped, the weighting material remains in position so that when rotation is resumed, the tire and wheel are still substantially in balance.

It will therefore be apparent that the present invention resolves the problem of the balancing of wheels of vehicles, including motor vehicle wheels and the like, and tends to maintain the balancing material in an appropriate balancing position within the interior of a tire regardless of the position in which the wheel or tire stops. Among the objects of the invention is the provision of means to automatically and accurately correct imbalance in wheels in travelling vehicles, so as to reduce vibration and lessen wear in shock absorbers, steering mechanisms and other parts of the vehicle, while at the same time providing means for so balancing wheels of vehicles that the wheels will remain substantially continuously in balance regardless of the position thereof, such as for example, when the vehicle is brought to a stopped position.

The liquid conveyor additionally serves to preserve the interior surface of the tire in an effective manner, and presents no difficulties

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as regards tire wear or deterioration of the tire material. It has also been found, in actual use, that the liquid carrier acts within the tire, upon circulation thereof to provide fine or precise balancing. The liquid conveyor also acts as a lubricant to reduce the friction involved. No deleterious effects have been found in use of the material.

Further objects and advantages of the present invention will be more readily apparent from the subsequent description of drawings, in which:

Fig. 1 is a radial sectional view of a tire and a portion of its wheel showing injection of the balancing material from a can thereof in accordance with the present invention;

Fig. 2 is a similar sectional view through a tire in which the balancing material has been placed, showing a differentiation between the heavier weight balancing material, and the liquid conveyor.

Fig. 3 is a schematic planar-sectional view of a tire, and balancing material contained therein similar to that shown in Fig. 2 of the drawings;

Fig. 4 is an enlarged diametric sectional view of a tire having its beads distended showing the interior of a tire cavity with the balancing material of the present invention disposed therein;

Fig. 5 is a diagram illustrating the operation of the invention to balance the tire; and

Fig. 6 is an enlarged fragmentary sectional view through a tire utilizing the present invention and showing the counterbalancing material as deposited therein upon rotation of the tire.

Referring in greater detail to the drawings, a vehicle wheel is generally designated at 10 in Fig. 3 having a tire 12 mounted thereon. It is to be understood that the present invention is equally applicable to use with both tubeless tires and tires which have tubes mounted therein.

In Figs. 2, 3 and 4 of the drawings are depicted the results of deposition of the material upon subsequent rotation of the wheel at a sufficient speed to separate the various components thereof. The composite material contained in the can includes at least three components, including a heavy weighting material, adapted to be deposited against the lighter side of a tire and wheel combination, such as a weighting particulate material 42. The composite material also includes a positional retaining material which consists of various constituents to which reference will be made. The composite material also contains a liquid conveyor, such as generally indicated at 44. This latter material serves as a liquid insertion and conveying agent for the heavier material, as explained above.

Referring to Figs. 2 and 3 it has been found that, under normal operating conditions of a vehicle, speeds in excess of approximately twenty-five miles per hour generate adequate centrifugal forces to displace or dispel the material 42 of a heavier nature from the overall consistency of the composite material placed within the tire, and due to a prelubrication or wetting of the interior of the tire by the liquid conveyor 44, to adhere the heavier material 42 and retaining material against the interior surface of the tire, at least temporarily, to counterbalance any imbalance existing in the tire and/or in the wheel and tire combination. As is well known in the art, wheel and tire combinations many times are out of balance due to imperfections in the manufacture of the tire *per se*, which can and many times do include areas which are heavier than others. An imbalance in a wheel and tire combination can also be imposed by virtue of the weight and positioning of the valve stem 24.

A normal correction method for such imbalance usually includes the external placement of weights, including materials such as lead, which are affixed to the exterior of the wheel rim, and many methods have been devised to ascertain where such weights should be placed. In practice, however, such external disposition of weights tends to create a further subsequent imbalance in a tire resulting in greater wear due to centrifugal forces caused by the location of the weights on the wheel. The present invention overcomes these difficulties, as well as the problems caused by placement of wheel weights on only one axial side of a wheel, which results in an axial displacement of balance from the desired plane which extends symmetrically through the tire and wheel normal to its axle.

Fig. 4 of the drawings schematically shows the disposition of the balancing material within a tire. This view shows the beads of the tire distended at 48; as for an examination of the interior of a tire in which the present material has been used. The tire 12 is of a usual construction. The tire 12, however, is assumed to have a light area, which necessitates balancing the tire and wheel combination. The present material, including the heavier weighting material 42 and the positional retaining material, herein generally designated at 40, tends to flow into, and cover the light area of the tire, on the far side as the tire as viewed. The positional retaining material is conveyed by the liquid conveyor 44 with the weighting material and is positioned between the weighting material and the center of rotation incident to centrifugation to provide a balancing condition. The material of the present invention generally tends to assume an oblate configuration, as indicated at 50 in Fig. 4, primarily due to a breaking out of the heavier material from the suspending material and subsequent deposition of the heavier material in the light cavity. The oblate configuration varies and normally is

not symmetrical within the tire cavity, depending upon side or radial imbalances within the wheel.

Fig. 6 pictorially shows the position of the materials which results from deposition of balancing material in the tire. Here a portion of the tire 12 is shown with the weighting material 42, its conveyor 44 and its positional retaining material 52. With a balancing material of the present invention deposited in the interior of a tire and upon rotation of the tire there is a centrifugal force applied to the particulate weighting material as indicated by arrows in Fig. 6. This force tends to move the particulate weighting material outwardly to the lighter side of the tire where it is deposited to create a balanced condition.

This phenomenon is best illustrated by reference to Fig. 5. In a rotating body of unequal or eccentric weight distribution, the centre of gravity is closer to the heavy portion of the rotating body than it is to its lighter portion. When rotated, the body tends to rotate about its centre of gravity, as designated by the term "centre of gravity of wheel and tire" rather than about the dimensional "centre of the wheel". Similarly, when an unbalanced wheel and tire are rotated, their center of gravity and center of rotation are closer to the heavy portion of the tire than to the lighter portion. This results in longer radii from the center of gravity of the rotated unit to the lighter portions of the tire than to the heavier portions. Use of the fluid balancing material of the present invention overcomes or compensates, for this differential in radii and unbalanced condition, and causes the balancing material inserted within the tire to flow to the area of the longer radii, i.e. the lighter portion, thus tending to balance the tire and wheel combination. Centrifugal force tends to throw a material within an enclosure to the outer extremity thereof. In the present circumstance, wherein the tire and wheel do not rotate about the center of the wheel as shown in Fig. 5, the entire entity tends to rotate about the indicated center of gravity of the tire and wheel. This in a significant degree is permitted by modern suspension systems and tire resilience.

Many materials can be used to effect the desired results of the present invention. As employed herein, "weighting material" is intended to comprehend the materials designated by the term in the oil-well drilling-mud art. They are of relatively high specific gravity, particulate, and have flowability and are characterized by galena, which is lead sulphide, other lead compounds, iron oxides, barite i.e. barium sulphate, ground marble, or the like. It must be flowable in the sense that it can be poured and it must be sufficiently dense to accomplish its balancing effect as well as to be subject to substantial separation from the liquid conveyor by centrifugation.

The positional retaining material comprises a solid suspension agent which, upon mixing with a portion of the liquid conveyor forms a gel of sufficently high viscosity to suspend the weighting materials therein. Many suitable solid materials have been found which are usable in this connection. As one example, a finely ground asbestos used basically in low-solid mud systems, can be used as a solid suspension agent. It has also been found that calcite, attapulgite clay, bentonite, and hectorites are useable. These materials are the viscosity builders or gel forming agents known in the oil-well drilling-mud art. The main function of this retaining material is to retain the weighting particulate material in the desired area of the lighter side of the tire and tend to prevent its displacement therefrom.

Due to the use of the liquid conveying material, however, when a further imbalance in the tire and/or tire wheel combination occurs there can be a gradual movement of the particulate material, into a new position to again correct any substantial amount or degree of imbalance of the tire. This action occurs by a creeping of the heavier particulate material and its retaining material around the interior of the tire.

In order to facilitate usage of the material which creates the main balance of the tire, the interior of the tire is preconditioned, and a wetted surface afforded. This is achieved by the liquid conveyor 44 can consist of many known materials but preferably a material such as glycerol, commonly heretofore known under the term of "glycerine". Other suitable liquid conveyors are ethylene glycol, monoethanolamine, dimonoethanolamine, trimonoethanolamine, ethylene glycol n-butyl ether, diethylene glycol ethyl ether, bisphenol A and the polyglycols.

The present invention is useful in practically all pneumatic or inflated vehicle tires. Under some circumstances it is desirable to adjust the proportions of materials to accommodate various anticipated weights and forces and to include distinctive dye material so as to be able to readily differentiate between materials suitable for different uses.

EXAMPLE

glycerine	50 gallons
bentonite (or barite)	300 pounds
Flo-Sal (finely ground asbestos)	7 pounds
Dye added for desired color.	
Propellant used in cans-Freon.	

To mix: Circulate the glycerine with a centrifugal pump, drawing from bottom of a vat, and returning to top of vat. Add 300 pounds of bentonite, circulate two hours and mix. Add 7 pounds of Flo-Sal, circulate thoroughly, for approximately two hours.

As set forth, other weighting materials,

other positional retaining materials and other liquid conveyors can be used insofar as the weighting material is of sufficient specific gravity substantially to centrifuge from the retaining material and liquid conveyor during tire rotation and insofar as the retaining material and liquid conveyor constitute a non-hardening holding medium for the weighting material suitable to hold the latter in position against a tire wall but to facilitate repositioning thereof upon subsequent imbalance of the tire.

Alternative positional retaining materials consist preferably of soft gels such as attapulgite clay used for increasing viscosity in salt or brackish water muds.

Typical physical and chemical properties of the described bentonite are:

	Coarse Grind	Fine Grind
Screen Analysis		
Through 20 Mesh	99.9%	100.0%
Through 30 Mesh	92.0%	99.9%
Through 40 Mesh	75.0%	92.0%
Through 100 Mesh	22.0%	23.0%
Through 200 Mesh	4.0%	3.5%

Chemical Analysis	
SiO_2	55.44%
Al_2O_3	20.14%
Fe_2O_3	3.67%
CaO	.49%
MgO	2.49%
Na_2O	2.76%
K_2O	.60%
Bound Water	5.50%
Moisture at 220°F.	8.00%
TOTAL	99.09%

X-Ray Analysis

85% Montmorillonite
5% Quartz
5% Feldspars
5% Cristobalite
2% Illite
1% Calcite & Gypsum

Miscellaneous Properties	
Specific gravity of dried material	2.79
Specific gravity of natural material	2.00
Fusion temperature	2444°F.
Weight of dried bulk unpulverized	71 lb. per cu ft
Weight of pulverized material	61 lb. per cu ft
Weight of crude, crushed undried material	80 lb. per cu ft.
Refractive index	1.557
pH of 6% water suspension	8.8

WHAT WE CLAIM IS:—

1. A tire balancing material comprising a particulate, flowable, weighting material; a viscous, substantially non-hardening, positional retaining material having the weighting material suspended therein in discrete particulate form, the weighting material being of a higher specific gravity than the positional retaining material for appreciable centrifugation therefrom incident to tire rotation, said weighting material in use being releasably retained in position in the tire by said positional retaining material upon said centrifugation, and a non-drying liquid conveyor.

2. A material according to claim 1 in substantially homogeneously mixed condition, and in which the weighting material has the highest specific gravity, the positional retaining material has a somewhat lower specific gravity, and the liquid conveyor has the lowest specific gravity for substantial centrifugal separation incident to tire rotation.

3. A material according to claim 1 in which the weighting material is a particulate solid of a higher specific gravity than the positional retaining material and the liquid conveyor.

4. A material according to claim 1, 2 or 3, wherein said positional retaining material includes a solid suspension agent which expands to form a gel when mixed with a portion of said liquid conveyor the remaining portion of said liquid conveyor being of a specific gravity less than that of the positional retaining material so that upon tire rotation the positional retaining material is centrifuged from the remaining portion of the liquid conveyor to retain the weighting material in place.

5. A material according to claim 4 in which the positional retaining material includes as the suspension agent thereof an ingredient from the group consisting of powdered asbestos, attapulgite clay, bentonite, calcite and hectorites.

6. A material according to any one of claims 1 to 5, in which the liquid conveyor consists of glycerol, ethylene glycol, monoethanolamine, dimonoethanolamine, trimonoethanolamine, ethylene glycol n-butyl ether, diethylene glycol ethyl ether, bisphenol A, or polyglycols.

7. A material according to any one of the preceding claims, wherein said positional re-

taining material is releasably adherent to the interior of a tire.

8. A method of balancing a vehicle tire comprising depositing in the interior of the tire a composite material according to any one of claims 1 to 7, and rotating the tire at a rotational velocity sufficient to throw the composite material to an area of the tire of relatively lighter weight than the rest of the tire and appreciably to centrifuge the weighting material to that area, the positional retaining material being releasably adherent to the interior of the tire.

9. A tire balancing material according to claim 1 substantially as herein described with reference to the described examples.

10. A method of balancing a vehicle tire according to claim 8 substantially as herein described with reference to the accompanying drawings.

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1209696 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

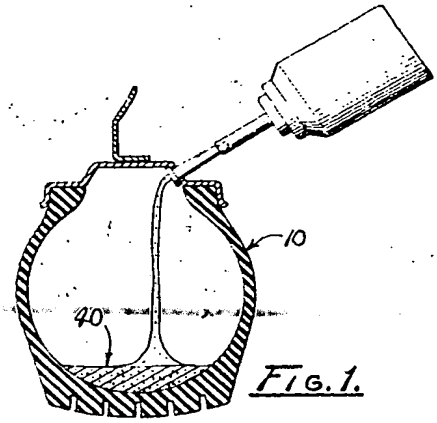

FIG. 1.

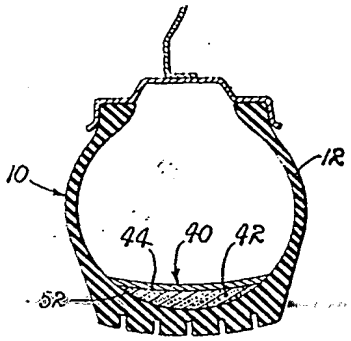

FIG. 2.

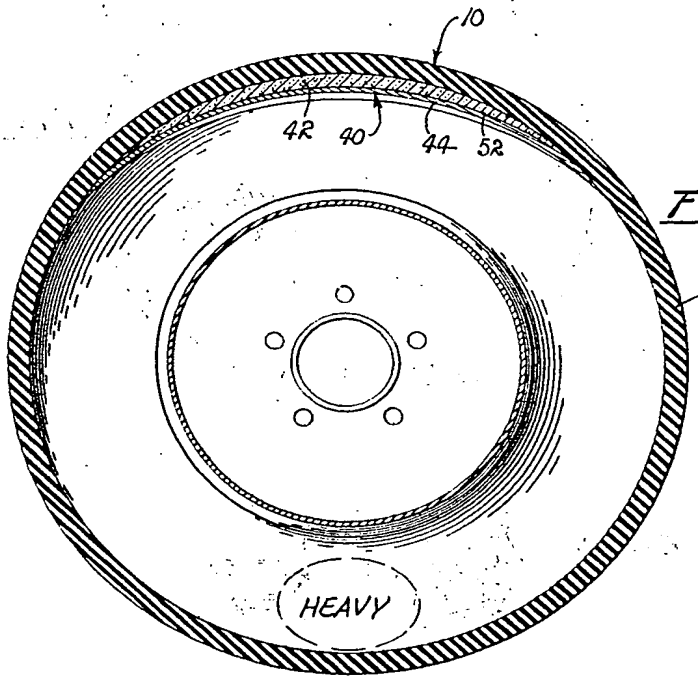

FIG. 3.

1209696 COMPLETE SPECIFICATION
2 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 2

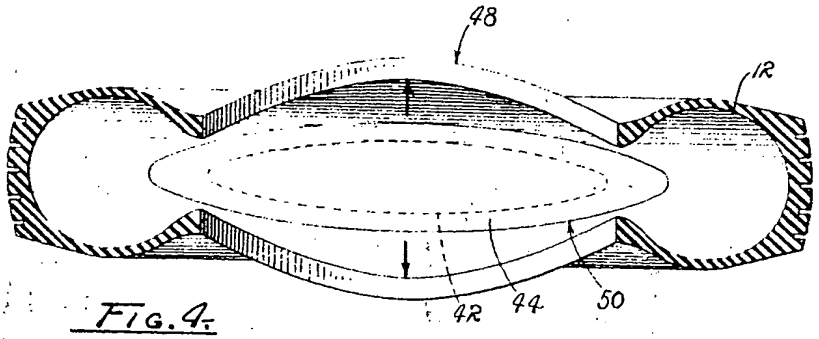

FIG. 4.

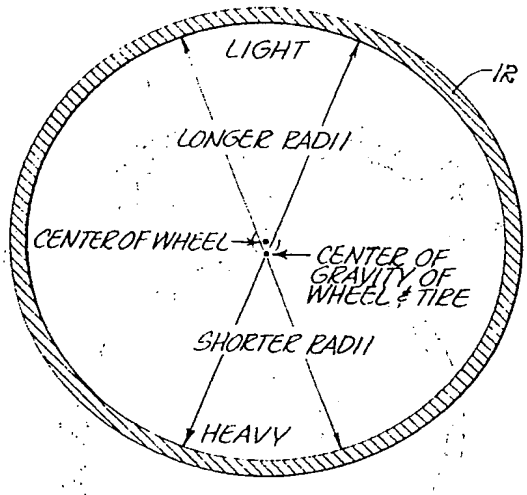

FIG. 5.

FIG. 6.